The Development of the Atomic Model (I)

Democritus (5th century B.C.)

- Greek philosopher that hypothesised that all matter is made of _____ and _____ particles, which he called "_____".

John Dalton (1808)

- Developed the concept of an _____ with greater detail than that of Democritus
- Dalton's atomic theory can be summarized as follows:
    - All elements are composed of tiny _____ particles called atoms.
    - Atoms of one element are _____, but different from all other elements.
    - Atoms of different elements _____in whole number ratio to form compounds.
    - A chemical reaction is the _____of atoms (atoms are neither _____ or _____).
- Dalton proposed a "_____" model of the atom.
- His atomic theory explained three laws that were known at the time:

1. The Law of Conservation of Mass (Lavoisier - 1789)
    - *Mass can neither be _____or _____.*

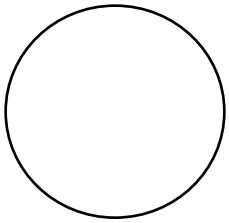
2. The Law of Definite Proportions (Proust - 1799)
    - *The proportions of elements by mass remain _____in different samples of the same compound.*

3. The Law of Multiple Proportions (Dalton)
    - *When atoms can react together to form _____ elements, the masses of the second element combined with the first element of a constant mass will result in a ratio of small whole numbers.*

- Some drawbacks of the Dalton's atomic theory:

J.J. Thomson (1897)

- Studied electric currents in gas discharge tubes, particularly _____.
- Cathode ray tubes:
  - A glass tube in which most of the air is _____.
  - They emit rays, called cathode rays, which are normally invisible, but when they collide with the remaining _____in the tube the rays become visible.
- Noticed that cathode rays were _____ to the positive side of a magnet and _____ by its negative side.
- Determined that the cathode rays were in fact streams of _____ _____.
- This discovery showed that the atom is _____.
- Based on his studies, Thomson proposed the "_____" model of the atom:



Ernest Rutherford (1910)

- Conducted the famous _____experiment with the help of two of his students.
  - Directed _____ particles (positively charged particles) at very thin sheets of gold foil.
  - Most alpha particles travelled through the gold foil _____or _____ deviating from their path.
  - Some of the alpha particles were _____ deviated, even to the point of going back to where they were launched.
- From their results, they concluded:
  - Atoms are mostly _____.
  - Positively charged particles are concentrated in the _____ of the atom, which Rutherford called the _____.

- Based on the findings, Rutherford proposed the following "_____" of the atom:

- Limitations of Rutherford's atomic model:
  - A nucleus composed only of positive charges would _____ apart because of the electrostatic forces of _____.
  - The model does not explain the _____ of the atom.
  - According to scientific law and physics, electrons in motion around the nucleus would _____ energy due to radiation causing its radius to _____, and thus would cause the electrons to spiral in towards nucleus and _____ the atom.

Questions (based on questions on p. 173 of textbook):

1. How did Dalton's atomic theory help explain the laws of conservation of mass? What are some of the shortcomings of Dalton's atomic model?
2. A friend of yours is confused about why Thomson's model of the atom was sometimes called the "plum pudding" model. How would you explain this to your friend? Is there a similar analogy you can use that might be more familiar to your friend?
3. Draw a diagram of what Rutherford and his students expected to happen when they directed alpha particles at the gold foil if the Thomson's model of the atom was correct. What did they observe when they performed their experiment (include a diagram)?
4. How did Rutherford's gold foil experiment support that the atom was mostly empty space? Why did Rutherford conclude that the nucleus was positively charged?
5. Describe the contributions of Dalton, Thomson, and Rutherford to the development of the atomic structure.